# THE GREVY ZEBRA AS A DOMESTIC ANIMAL

## For Crossing It Possesses Much More Finish Than a Jack—Difficulties of Hybridizing—Success by Artificial Means—No Sign of Telegony

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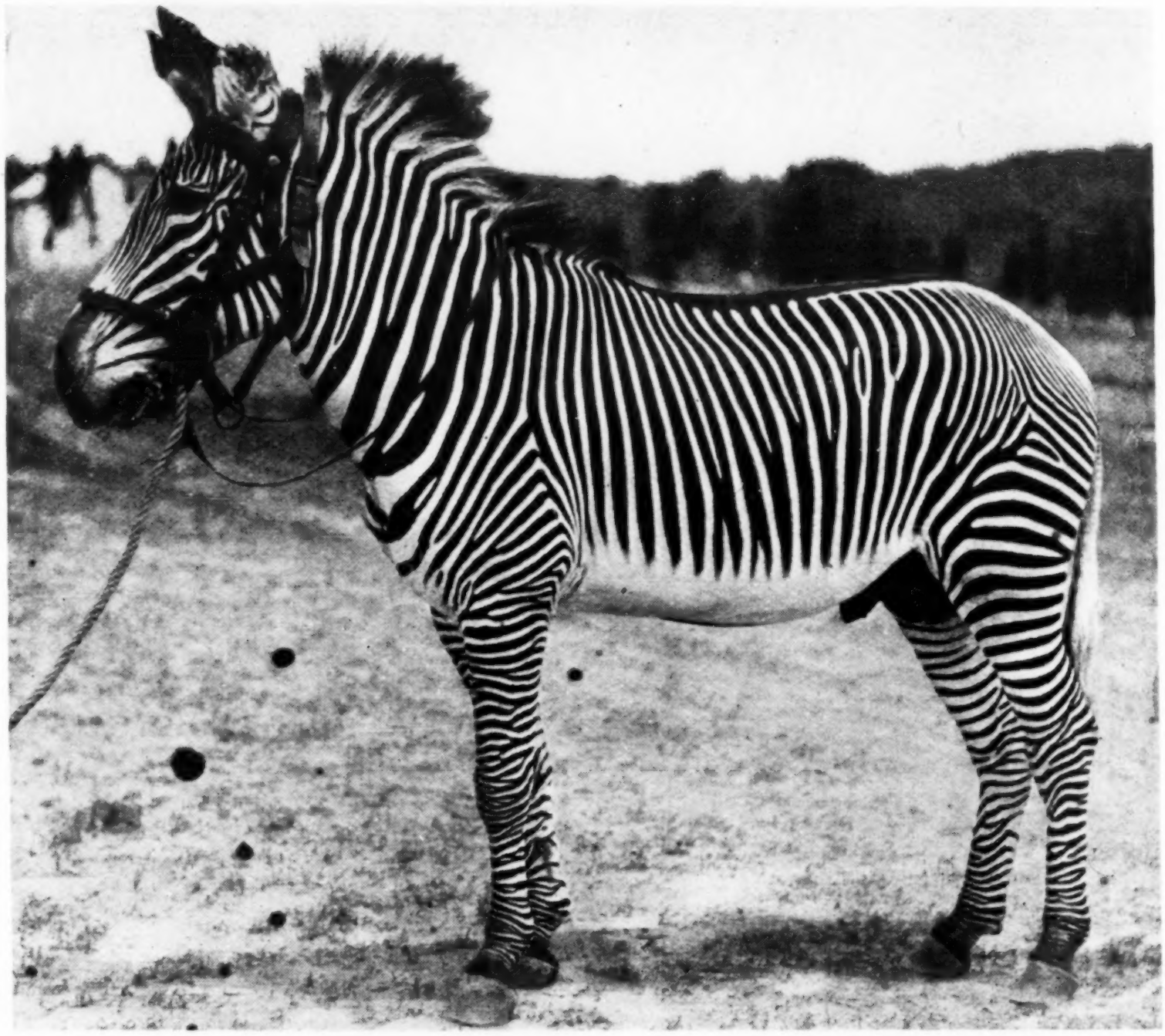
The Grevy zebra (*Equus Grevii*) is one of the few known wild animals which promise to have value for the use of mankind, but with which few attempts at domestication have been made. It is the largest of the zebras, measuring between thirteen and fourteen hands and weighing about 800 to 900 pounds at maturity. It is also by far the handsomest of its kind—a splendid animal, with striking markings which are distributed in a beautiful pattern over the body and legs.

This zebra inhabits the highlands of Abyssinia and Somaliland in Africa and apparently is comparatively rare. Many people believe that it would be worth domesticating and that by systematic feeding and breeding its size can be increased and its numbers likewise.

Popular attention in the United States was first directed to this animal in 1904, when the late Emperor Menelik of Abyssinia presented a number of animals to President Roosevelt, among them being a male Grevy zebra, which was promptly christened Dan. This animal, secured largely through the initiative of Hon. Robert P. Skinner, special commissioner to Abyssinia, and Dr. Baker, of the National Zoological Park, was placed with the others in the donation at the Zoological Park in Washington, where he received a great deal of admiration. Perhaps the first American who conceived the idea of using this zebra as a sire of mules was the present Postmaster General, Hon. A. S. Burleson, then a Representative in Congress and a member of the House Committee on Agriculture. At any rate, this idea was an active one with Mr. Burleson, and he



**JERRY, A MALE GREVY ZEBRA.**

He promises to have value as a domestic animal because his disposition is reasonably good, and he has "finish." The breeder of common mules must depend on the mares for finish; in breeding mules from the zebra, finish can be obtained from the sire also. It has been necessary to make the cross artifically, but success by natural means may be obtained later, since it has been done with Burchell's zebra.

induced the Bureau of Animal Industry to take up the experiment in crossing the zebra with mares. The consent of the President was obtained to use the zebra for this purpose, and in the spring of 1905 a cooperative agreement was arranged with the National Zoological Park and the Maryland Experiment Station to carry on the work. Six good-sized farm mares were purchased. Five of them were grade Percherons weighing 1200 to 1400 pounds, and the sixth a grade coach mare weighing about 1200 pounds. For a year attempts were made to cross the zebra direct with the mares at the Zoological Park without results.

The Bureau reached the conclusion that a zebra was somewhat

like a jack and, if he had not been raised with horses, might show some disinclination to mate with mares, or even refuse to do so at all. Therefore, arrangements were made with Hon. Robert P. Skinner, then American Consul General at Marseilles, France, to obtain a pair of Grevy zebras so that the Department could begin breeding zebras. Mr. Skinner induced the Ras Makonnen, Governor of Harrar, Abyssinia, a potentate next in power to the Emperor, to present a pair of zebras to our Government. He did so in 1905, but the female died on the railroad while being shipped to the port of Djibouti. The male arrived at New York on January 30, 1906, and in a couple of days reached the National Zoological Park in Washington in good condition. He was young and in fine condition but misfortune had set mark on him also, and on a fine day during the following spring he met with an accident which killed him.

In August, 1906, the original Grevy zebra, Dan, and his equine consorts were transferred to the Experiment Station of the Bureau of Animal Industry, near Bethesda, Maryland, and shortly thereafter some small mares were purchased with the idea that perhaps the zebra might mate more readily with an animal more nearly his own size. After a year or more of discouragement, this was given up in the case of this particular zebra. He evinced a positive aversion to them, although he was kept in the same stable with them for weeks so that a mutual acquaintance could be established. When it was finally decided to turn the zebra and one of the mares into the same paddock, Dan rushed at the mare and would undoubtedly have killed her had he not been driven back into his stall.

There were, at the Station, a number of the small asses of the Southwest, commonly known as burros, and it was soon found that Dan would mate with them readily. These animals were later supplemented with a fine Kentucky jennet which was also bred to Dan. A number of hybrids of this mating have been obtained which have been described in previous articles.*

Meanwhile the Bureau kept at the problem to establish a stud of zebras. In the spring of 1907, Consul-General Skinner was ordered to purchase a pair of Grevy zebras. They arrived in September of that year, but the female died from a ruptured liver

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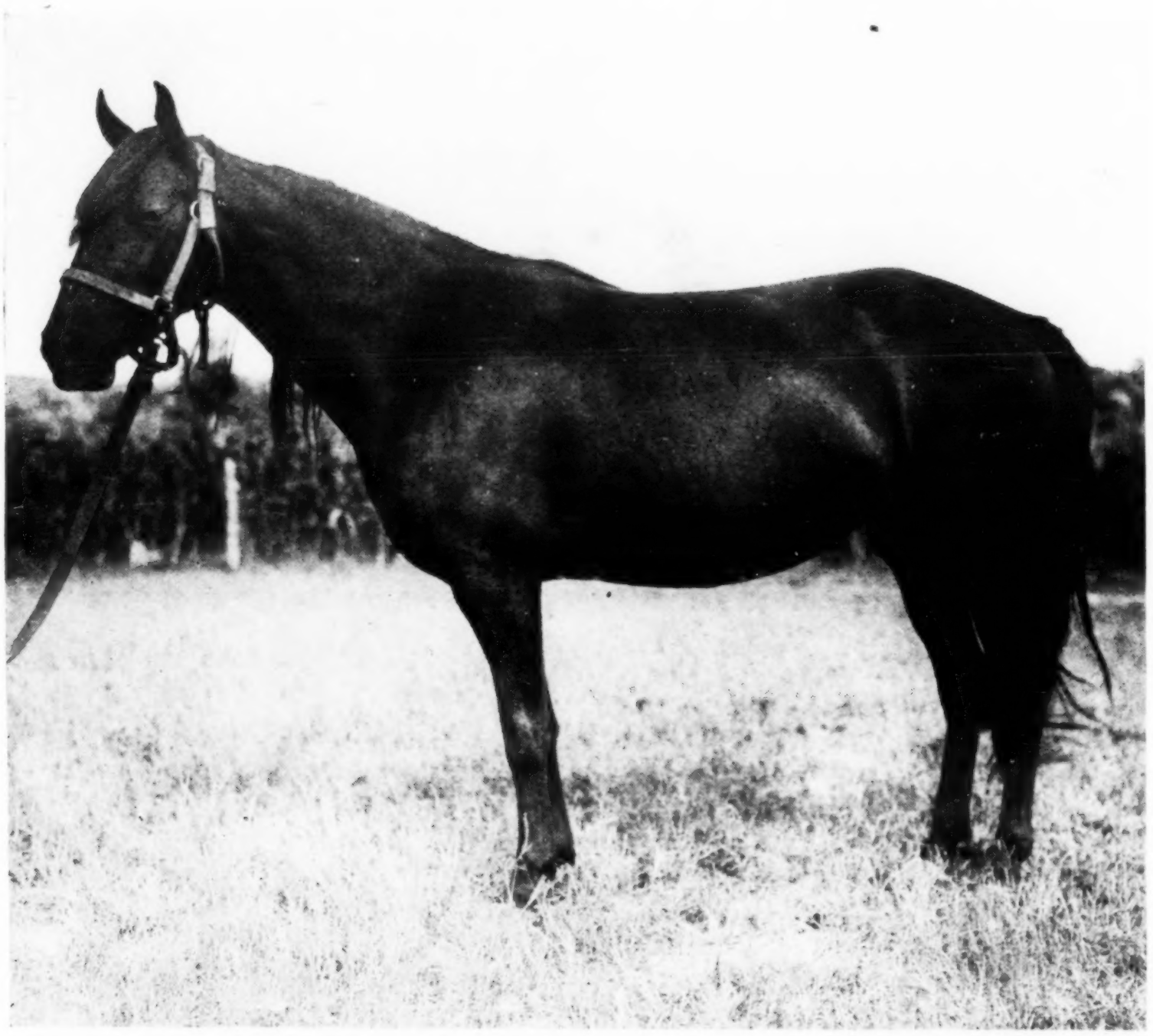
* "A Note on Zebra-Hybrid Breeding," by E. H. Riley, 26th An. Rpt., Bu. An. Ind., pp 229-232.
"A New Zebra-Hybrid," by E. H. Riley, A. B. A., Vol. VI, pp. 72-75.



**THE MOTHER OF THE ZEBRA HYBRID.**

The registered Morgan mare, Baby Gates, Vol. III, A. M. R., by General Gates (666), dam Polly B, Vol. III, A. M. R. She first foaled the Grevy zebra hybrid Juno and then the pure-bred Morgan filly Georgia, Vol. IV, A. M. R. If telegony were a fact, the latter foal should have shown some stripes, as a result of the previous impregnation by the zebra; no stripes were shown, however, and it is concluded, on this and much similar evidence, that telegony has no foundation in fact.

shortly after reaching the Experiment Station. However, the male, Jerry, lived and is now in the Bureau's possession. In April, 1908, two female zebras were received from the same source. At last we felt that we had made a start at establishing a stud; but again misfortune dogged our tracks and one of these females died of heart trouble in October, 1908. The other was bred to Dan and gave birth to a dead female foal on September 22, 1909.

In 1910 the Bureau acquired its experimental farm near Beltsville, Maryland, and Dan was returned to the National Zoological Park, where he is quartered with one of his burro hybrids in the

same stable. Jerry, the female zebra, the asses and the remaining hybrids were transferred from Bethesda to the experimental farm.

Jerry had been kept away from the female zebra and out of her sight as much as possible. He was a young animal when received, and we thought that he had probably never covered a female zebra and would therefore be more likely to cover a mare. To test his availability as a sire of mules, two young fillies were sent to Beltsville from the Morgan Horse Farm in the spring of 1911. They were Isabel, a three-year-old, and Baby Gates, a four-year-old, both registered Morgans; neither had been bred. These fillies were turned into a paddock with Jerry. He did not show Dan's antipathy to mares; in fact, the three became very good friends, but no mating resulted. The mares came in heat regularly and Jerry manifested a certain amount of sexual excitement. He would mount but, for some peculiar reason, would not complete the act.

After months of these trials without results, the female zebra was bred to Jerry; she had produced a foal which was dead at birth and we felt that we could not afford to lose the chance of getting a living foal from her. Whether breeding Jerry to a female zebra would cause him later to refuse to cover asses was of little consequence. The female was bred, and Jerry was then tried on the asses; strange to say, he covered them without objection. Why Jerry should refuse to cover mares when he had probably never mated with his own species, but would readily go to asses after he had mated with a female Grevy zebra, is a question in animal psychology the writer does not presume to answer. It should be mentioned that breeding Dan to the zebra female did not make him less ready to cover asses, but the first females Dan covered were asses and he was not put to a female zebra until over a year thereafter. In Jerry's case, his first mate was the female Grevy zebra. Here we may note a peculiar difference in temperament between Dan and Jerry. Dan absolutely refused to cover anything if a human being was within sight or hearing; an audience at this time is a matter of supreme indifference to Jerry.

The last zebra female died suddenly in August, 1911. Post mortem showed the cause of death to be impaction of the bowels, and the uterus contained a fetus about one month old.

Copulation being readily performed by the zebra with female donkeys, it was of course easy to collect semen to impregnate mares

**JUNO, A ZEBRA-MARE HYBRID.**

Foaled June 2, 1912, out of the registered Morgan mare Baby Gates, Vol. III, A. M. R.; sired by the Grevy zebra Jerry. Juno weighed 570 lbs. on September 12, 1913; her dam weighs 850 lbs. Compared with the zebra-ass hybrid, the neck is longer, more flexible and cleaner-cut, and the back more compact and shorter, while her disposition is also good. These characteristics make her more desirable for domestic use than the ass hybrid.

artificially. This was begun as soon as Dan began to cover the asses. The semen was collected in five c. c. gelatine capsules as soon as possible after service and a capsule inserted by hand into the uterus of the mare. One mare was got in foal in this manner while the work was at Bethesda and three at Beltsville. The first mare and one of the latter lost their hybrid foals, one of the latter was condemned and sold, having since foaled a zebra hybrid, by Jerry, and the fourth is the Morgan mare, Baby Gates, who foaled a female hybrid by Jerry on June 2, 1912.

It has been found that the zebra semen does not contain rela-

tively so many spermatozoa as that of the stallion, and this may account for much of the difficulty in breeding by artificial means. For several years, it was our custom, whenever a donkey was bred (which was frequently) to collect the semen, hobble all the mares and insert a capsule in each one. There were from five to ten mares on hand all the time and these mares were artificially bred many times a year. The mare which was sold was one of the most disappointing of all. She always appeared to be in foal some months after being "capsuled," but just as regularly proved not to be. When she was reported as in foal some weeks after her sale, it was believed to be a false alarm as usual, but subsequent events proved the contrary.

The first zebra mare hybrid was foaled in June, 1912. It is now being fed with young horses and in many respects is a promising animal. The ass hybrids do not appear to have much value as work animals. We have handled a number of them, and have one pair that worked regularly for some months, but they are decidedly stubborn and very hard-mouthed, which is not to be wondered at. When we consider the stubbornness of the donkey coupled with that of the zebra, which is as much, if not more, we can hardly expect an increase in docility and tractability in the resulting offspring. The ass hybrids are decidedly donkey-like in disposition and habits. When young, they trail along after their dams through the paddocks, no one in a hurry or in the least excited.

The mare hybrid, on the other hand, is more like a horse in appearance and manners. When a little thing she would always keep close to her dam, usually on the side away from the visitor, and in following her through the field would keep close up to her. She has the alert, spirited air of a mule which one would expect from a high-spirited, well-bred mare. Of course, the mare hybrid is yet too young to determine what sort of a work animal she will become.

The Grevy zebra has one characteristic, which, in our opinion, in the absence of any other would make it of value for mule production. It is a highly-finished animal,—an animal "with lots of quality," as the stockman would say. In breeding mules from jacks the farmer depends on the mare for finish and quality. With the Grevy zebra he gets it from the sire as well. Therefore, it would appear possible to breed a finer class of mules from the Grevy zebra than from jacks, using all kinds of mares, fine, medium and

**SHOWS NO TRACE OF "SATURATION."**

Registered Morgan filly Georgia, Vol. IV, A. M. R., by Pat Murphy; dam Baby Gates, Vol. III, A. M. R., by General Gates (666); foaled May 14, 1913; photographed September 4, 1913. Although the previous foal of her dam was by a zebra, Georgia shows no trace of the influence of this previous impregnation—an influence which has been claimed by many to exist, and is called telegony. Georgia is thin; apparent stripes are merely the ribs.

coarse. It is not to be doubted that the size of the Grevy zebra can be considerably increased by selection and feeding, once sufficient numbers are gathered together under the conditions of domestic animal life.

No one need fear that the Grevy zebra can not be handled under farm conditions. He is now to be classed as a wild animal, of course, but so is the elephant until man captures him. Our Grevy zebras have been no more difficult to handle than stallions or jacks. They are stubborn; so is a jack. They may be made vicious by improper and vicious handling; so may a stallion or jack. The

zebra is not a child's toy, but neither is he a savage wild animal, absolutely without amenability to the control of man. The Grevy zebra is susceptible to domestication, and a thorough trial of his possibilities is well worth while.

Every one is familiar with Ewart's classic experiments in telegony, where he used the Burchell zebra and small mares of pony type. These investigations seem to prove conclusively that the influence of one impregnation of a female has little, if any, effect on the characteristics of subsequent progeny.* In our work it was possible to confirm that of Ewart. The mare, Baby Gates, had never been bred until she was artificially impregnated with zebra semen. Her first foal was the female hybrid, Juno, by the Grevy zebra, Jerry, born June 2, 1912. At the first period of heat she was bred to the registered Morgan stallion, Pat Murphy, and foaled the filly Georgia on May 14, 1913. This foal shows no evidence in any particular of the influence of the zebra impregnation. It is strongly like its sire, and promises to develop into a handsome, stylish mare. In some of Ewart's cases, stripes have been apparent at birth, but these disappeared subsequently, and Ewart believes their presence to be due to reversion to an ancient horse type and not to telegony. As stripes are frequent among the pony stock of northern Europe, his explanation seems to be correct. Stripes are common among mules in the United States, but rare among horses or ponies. The complete absence of stripes as a result of reversion in the filly Georgia was to be expected.

It is also interesting to note that Baby Gates was a twin. The other, a male, was dead at birth. Baby Gates was very weak when born and weighed only 42 pounds (less than half the normal birth-weight for Morgan foals), but hot blankets and careful nursing saved her. Twin foals are unusual and are rarely raised. It should also be noted that Baby Gates is what cattle breeders call a "free-martin"—twinned with a male—yet she produces readily. Some cattle breeders believe that free-martin heifers are sterile, although the cattle herd books abundantly disprove it. The case of Baby Gates indicates that "free-martin fillies," if we may use the term, will also breed.

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* "The Penycuik Experiments," by J. Cossar Ewart; A. & C. Black, London, 1899.

"Guide to the Zebra-Hybrids, Etc." by J. Cossar Ewart; T. & A. Constable, Edinburgh, 1900.

**A ZEBRA-ASS HYBRID.**

This cross is made without much difficulty but promises no commercial value because of the stubbornness of the animal—a characteristic to be expected, since it inherits stubbornness both from its zebra sire (Dan) and its burro mother. Its stripes show more plainly than do those of the mare hybrid because its coat is lighter in color, although the body color resembles that of the dam in both cases.

A number of cases have been recently reported, alleged to be instances of fertility in ass-mare hybrids,—common mules. It is apparently true that mare mules may secrete milk, but the milk-secreting function is not an infallible sign of maternity. It may be stimulated by artificial manipulation of the glands, and cases are said to be on record of the stimulation of milk secretion in males by manipulation of the rudimentary milk glands. Oestrum in females and sexual activity in entire males are usual in mules; neither phenomenon appears to be an absolute indication of fertility. However, it is a fair supposition that where nature has endowed animals with these phenomena, the possibility to reproduce may be present

and reproduction may occur. The fact that mules are not used for breeding puts a large number of chances against the probability of mules producing. If a large number of mules were experimented with, perhaps in time a fertile one might be found. However, the writer craves the privilege to question the accuracy of the accounts of this alleged occurrence which have been thus far noted. When the man who actually bred the mare mule is heard from, and likewise the man who was actually present when she foaled, his skepticism will be removed. At present there is always a weak point in the chain of evidence,—a point where the chain must be pieced together with supposition.

Our zebra-ass hybrids, both male and female, give every visible indication of sexual activity. They have been bred together; the females have been bred to Jerry (the Grevy zebra), and the males have been bred to donkey females. This has been done, not once or twice, but dozens of times, and by natural means. No foals have resulted, and none of the females are now pregnant, so far as we can observe. It would appear that the relationship between a zebra and a common ass is closer than that between the ass and the horse. Therefore, the possibility of fertility in a zebra hybrid would seem greater than that in common mules. Perhaps when larger numbers of zebra hybrids are available and more attempts are made with common mules, an undoubtedly fertile zebra hybrid or mule may be found.

In the absence of funds for the purpose, the Bureau is not planning to continue the work with the Grevy zebra. While we have been unable to mate the male zebra direct with mares, it does not appear to be impossible, in view of Ewart's experience with the Burchell zebra. We have made the cross with mares, which has given us a promising animal, and there seems to be no reason to think that the Grevy zebra would not be valuable as a farm animal if properly handled from birth.

# THE EUGENICS OF WAR

## Its Effect Principally on Heredity, and Wholly Pernicious—Military Training Cannot Compensate Because It Has No Effect on the Germ Plasm*

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The final argument against war and against all those accessories of war which, in the name of peace, invite war, is found in its effect on the breed of men. The destruction of the strong means the perpetuation of the weak. The loss of the bold, dashing and courageous means the rule of the cautious, the timid, the time-serving.

The waste of money in war and in armed peace, without parallel in the history of the world, "the endless caravan of ciphers" representing war debt and war expenditures, the earnings of poor men's lives spent in futile murder or in equally futile preparation for it, is but a small part of the toll exacted by war. The greatest waste of all is that of life itself. It is a well-established fact of biology that the laws in heredity which apply to man are those which govern the lower animals as well. "Like the seed is the harvest"—that is the fundamental law. The men you breed from determine the future.

Heredity runs level. No race of men nor animals has improved save through selection of the best for parentage. None has fallen save through the choice of inferior stock for parentage. Whatever influence may cause the destruction of the strong, the brave, the courageous, the enterprising, will ensure a generation which shall show these qualities in lower degree. Rome fell because the old Roman stock was for the most part banished or exterminated. There was no other cause. The Romans were gone and that was the end of it; while the sons of slaves, camp-followers, scullions, and peddlers filled the Eternal City. The republic fell when "Vir gave place to Homo," real men in Rome to mere beings. The em-

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* Address recently delivered in the home of the Duchess of Marlborough, London.

pire fell when the barbarians filled the unoccupied city, unoccupied so far as the men of the old Roman type were concerned.

The latest historian of the "Downfall of the Ancient World," Dr. Otto Seeck, of the University of Munster, tells us how, after the wars of Marius and Sulla, "only cowards remained, and from their brood came forward the new generations." We ask no other reason for the disappearance of Greece, Greek art, Greek philosophy, Greek literature, the perfection of form in thought, in action, in speech—all of these were impossible save to men of Greek blood; and when these had fallen in suicidal war, there was no longer the heredity which could replace them.

Some twenty years ago I visited the city of Novara, in Northern Italy. South of the town lies a wheat field, where the Sardinian army was once encamped and from which they were driven by the Austrians. A huge mound of human skulls tells the story. History tells the rest, but the significance of such events lies not in the fate of kings, nor does it lie in the fate of the men, nor yet in the waste of their lives, nor even in the sorrows of those who loved them. It is found in the effect upon the race.

But there are other piles and piles of skulls, none the less significant because the bones are buried. The walls of Paris tell their story—Metz, Worth and the slaughterfield of Sedan. Then we can trace our lines across Germany, Jena, Leipsig, Austerlitz—names called glorious in the history of the slaughter of young men—Lutzen, Bautzen, Ulm, Wagram, Hohenlinden. Let us pass them all to recall the grand army of Moscow, 600,000 men, the finest body of men that ever stood in line. Then let us recall the blasts of winter, the burning city, the lack of base of supplies, the hatred of the people of the invaded country. And after that let us see, with the historian, the pitiful retreat of the 20,000 men who remained of this great army. The historian tells us that:

"Amidst ever deepening misery they struggled on, until of the 600,000 men who had proudly crossed the Niemen for the conquest of Russia, only 20,000 famished, frost-bitten, unarmed spectres staggered across the bridge of Korno in the middle of December."

The inevitable result of the waste of vigorous life must be the loss to the nation of the qualities which are sought for in the soldier. It leaves the nation crippled, "une nation blessée." The effect does not appear in the effacement of art or science or creative imagina-

tion. Men who excel in these regards are not drawn by preference or by conscription to the life of the soldier.

Those who fall in war are the young men of the nation, men between the ages of eighteen and thirty-five; they are the men of courage, alertness, dash and recklessness, who value their lives as naught in the service of the nation. The men who are left are, for better and for worse, the reverse of all this, and it is they that determine what the future of the nation shall be. They hold its history in their grasp.

However noble, encouraging, inspiring the history of modern Europe may be, it is not the history we would have the right to expect from the development of its original elements.

All this applies not to one nation alone, nor to one group of nations, but in like degree to all nations that have sent forth their young men to the field of slaughter. As it was with Greece and Rome, with France and Spain, with Korea and Turkestan, with Morroco and with Paraguay, so has it been with Germany and England; so with all nations that have sent forth "the best they breed" to foreign service, while retaining cautious, thrifty mediocrity to fill up the ranks at home.

Four millions of men fell in Napoleon's campaigns. No wonder the life of Europe is impoverished. No wonder that France is a wounded union, as are all others whose men were caught up in that holocaust. Napoleon, it was said, "has peopled hell with the élite of Europe." Stacked up on the field, as at Novara, their skulls would make a pile twenty-five times as high as the tallest spire in Europe. To this cause of reversed selection almost alone we may ascribe the social and personal deficiencies of the common folk of Europe. To be "him that overcometh" one must have a lineage made up of those who were "captains of their fate" and "masters of their soul in their day and generation." If we send forth the best we breed, there is no way in which those of the future shall be other than second best.

In his charming studies of "Feudal and Modern Japan," Arthur Knapp mentions again and again the great marvel of Japan's military prowess, as shown in the Chinese war, after more than two hundred years of peace. It has been even more conclusively shown in the Russo-Japanese war since Mr. Knapp's book was written. His astonishment was that after more than six generations in which military drill was not the final aim of each young

man, the virile qualities of patience and courage were found unimpaired.

If after two hundred years or even twenty years of incessant battle Japan should remain virile and warlike, that would, indeed, be a marvel. But that marvel the world has never seen. It is doubtless true that military traditions and the physical strength to gain victories frequently engaged in war, but military traditions and the physical strength to gain victories are very different. Other things equal, the nations which, like Japan, have known the "old peace with velvet-sandaled feet" are most likely to develop the "strong battalions" on which victory in war is most likely to rest.

What now of Germany? She has had her share of the desolation and the degradations of war. It is said that in the Thirty Years' War the population of Germany was cut down from 16,000,000 to 6,000,000 people. It is said that not before 1870 was Germany able to regain the ground she held in 1618. It is, moreover, claimed that while Germany is military, she is not warlike. While there is no nation so dominated by the professional soldier with his mediaeval scorn of commerce, science and all civilian things, yet there is virtually not a man in the German army who ever saw a battle. The superiority of Germany lies in its science, its industrial art, its commerce, its intensification of civilian activities.

The evidence of the havoc of war is not so clear in Germany as in most other lands of Europe. Perhaps, as Dr. Seeck affirms, massacre and desolation destroyed the weak as often as the strong. Perhaps again the fact of universal compulsory education and compulsory industrial training, with compulsory insurance against old age, has greatly reduced the visible number of the unemployed and of the unemployable.

The factor of emigration which has filled the great cities of the new world with young Germans, ambitious and energetic, is one which we cannot estimate in comparison with the effects of war. When the best emigrate, the home lands become impoverished, but emigration gives new ideas and new experiences. The loss of one region is the gain of another, and the gain with good men overbalances the loss. The men of the New World are Old World men who have learned something in a new environment, lost something, perhaps, in exchange for all that is gained, but in the long

run the new advantages outweigh the old. But loss which is loss comes from the sacrifice of the strong.

What shall we say of England and of her place in the history of war? In the Norse mythology, it was the Mitgard Serpent which reached around the world, swallowed its own tail and held the world together. England has been this Mitgard Serpent. She has held the earth together. She has made this a British world. Her young men have gone to all regions where free men can live. They have built up free institutions which rest on co-operation and compromise. She has carried the British peace to all barbarous lands and she has made it possible for civilized men in security to trade and pray the world over. "What does he know of England who only England knows!" For the activities of Englishmen have been manifold, greater without than within the little island from which Englishmen set forth to inherit the earth.

What has all this cost? It could not be done unless it was paid for, and we must not wonder if such strenuous effort, such sacrifice of life and force, has left her with a certain degree of exhaustion. It may have been worth the cost. This we are not questioning. But it is well to realize that the cost has been tremendous.

"There's a widow in Sleepy Chester,
Who mourns her only son.
There's a grave by the Prabang river,
A grave which the Burmans shun."

If we would know why Chester is sleepy, we have only to turn to her great cathedral. The long north side of her red sandstone walls tells of her dead, the world over, and always the same story. Tablets to the memory of young men, gentlemen's sons from Eton and Rugby and Winchester and Harrow, scholars from Oxford and Cambridge, from Manchester and Birmingham and Liverpool, who have given up their lives in some petty war in some far-off country. Their bodies rest in India, in Zululand, on the Gold Coast, the Transvaal. In England only are they remembered, men who should have been the makers of empire.

These names are recorded in every cathedral, in every parish church, and the churches of England are numbered by the thousand.

The foreign service of England for a hundred years has furnished careers for the sons of the squire and the gentleman. For

a century Great Britain has sent her strongest and most forceful sons. "Send forth the best ye breed," and the nation breeds from the second best.

And in this loss of fair and strong, "the unreturning brave," we may find an answer to some of England's most desperate problems.

Why is it that three or four, or may be ten millions, of Englishmen are unable to earn a decent living, or any living at all, in England today? Why is it that these same unemployed are found unemployed in Canada, in Australia, or wherever they may go? Why is it that the tendency in all average physical standards is downward, while the standards of the best are growing always higher? The answer lies in the reversed selection of war. Its effects are found in England and everywhere else where strength and courage have been rewarded by glory and extinction. England has exchanged her country squires for the memorial tablet. More than for all who have fallen in battle, or were wasted in the camps, England should mourn "the fair women and brave men" that should have been descendants of her strong and manly men. If we may personify the spirit of the nation, England should most grieve, not over her unreturning brave, but over those who might have been but never were, those who so long as history lasts can never be.

"The best ye breed!" is war's insatiable call. Send your best, your fittest, your most courageous, your youths of patriotism and your men of loyal worth, send them all and breed your next generation from war's unfit remainder. Do that, as Scotland has done it, and what says your biology? Like father, like son. Like seed, like harvest. You cannot breed a Clydesdale from a cayuse, neither can the weakling remnant of a war nation breed a new generation of heroes for a new generation's wars.

But, we are told, war ennobles the nation. Did the British wars that drew 22,000 soldiers from the Isle of Skye ennoble the landlords who drove from their lands the very families that bred these men? Did the heroism of the Grants from Strathspey and Glenurquhart, and the deathless devotion of the clansmen from Kildonan and a hundred other glens, who saved the honor of the race at Lucknow and Cawnpore—did that awful slaughter ennoble the dukes and earls and lords who during that immortal sacrifice of the sons drove the fathers from the crofts and burned the sheillings where they were born?

By a strange confusion of cause and effect it has been assumed in some quarters that the waste of virility from war could be repaired by universal military drill. Assuming that such discipline gives increased physical and mental vigor, that fact would not appear in heredity—no training can raise a man above his possibilities, and it is the possibilities only that his children inherit.

The events in a man's life leave no trace in real heredity, and none in transmission except as the events may impair the vigor of germ cells. Moreover, we who believe in the value of sound physical training to the growing youth cannot admit that barrack life comes under this head, or that it is in any important degree a substitute for it. The drill assigned to the soldier comes too late in life to be of much value. It is narrow and limited in kind, with a sinister purpose behind it. It is under incompetent teachers to whom physical training is only an incident, not a means nor an end.

The camp is always a school of idleness, and usually of vice also. It interferes with the industrial or professional training which should be a duty of every young man to acquire. Moreover, if compulsory, all these evils are intensified. There is value in drill and in discipline. When these are voluntarily assumed they have large possibilities. But compulsory military service bears the same relation to the drill in competent schools that stoking a furnace bears to building one's camp fire in the forest.

In any event, this whole matter belongs among the problems of education and not at all to those of eugenics, with which lies the preservation of race-strength. By the law of probabilities as developed by Quetelet, it is claimed that there will appear in each generation the same number of potential poets, artists, inventors, patriots, athletes, rogues, superior and inferior men of each degree.

This law, however, involves the continuality of paternity, that in each generation a practically equal percentage of men of superior mentality will survive to take the responsibilities of parenthood. Otherwise this law becomes subject to the action of another law, that of reversed selection, or the biological law of "diminishing returns," as Quetelet himself indicated. In other words, breeding from an inferior stock brings race degeneration, and such breeding is the sole agency of such degeneration, as selection, natural or artificial, along one line or another is the sole agency for race progress. And all laws of probabilities and averages are subject to a still higher law, the primal law of biology, which no cross-

current of life can check or modify: Like the seed is the harvest; almost alike but never quite, but on the whole always following the lead. There is in fact no law save this: Under like conditions heredity runs alike, almost alike, but with like variations. When conditions change, so change the products of heredity.

What shall we say of America, with her years of peace, and her two great civil wars, the struggle of children with their parents, of brothers with brothers?

It may be that war is sometimes justified. It is sometimes inevitable, whether necessary or not. It has happened once in our history, that "every drop of blood drawn by the lash must be drawn again by the sword."

It cost us 650,000 lives of young men to get rid of slavery. I saw not long ago in Maryland one hundred and fifty acres of these young men. There are some 12,000 acres filled with them on the fields of the South. And this number, almost a million, North and South, was the best that the nation could bring. North and South alike, the men were in dead earnest, each believing that his view of state rights and of national authority was founded on a solid rock of righteousness and fair play. North and South, the nation was impoverished by the loss. The gaps they left are filled to all appearance. There are relatively few of us left today in whose hearts the scars of forty years ago are still unhealed. But a new generation has grown of men and women born since the war. They have taken the nation's problems into their hands; but theirs are hands not so strong or so clean as though the men that are stood shoulder to shoulder with the men that might have been. The men that died in "the weary time" had better stuff in them than the father of the average man of today.

Those states which lost most of their strong young blood, as Virginia, Louisiana, the Carolinas, will not gain the ground they lost, not for centuries, perhaps never.

# THE KAFIR ORANGE

## An Edible Member of the Strychnine-Producing Genus Which Succeeds in the United States—Numerous Relatives Also Promising for Tests by Plant Breeders

DAVID FAIRCHILD

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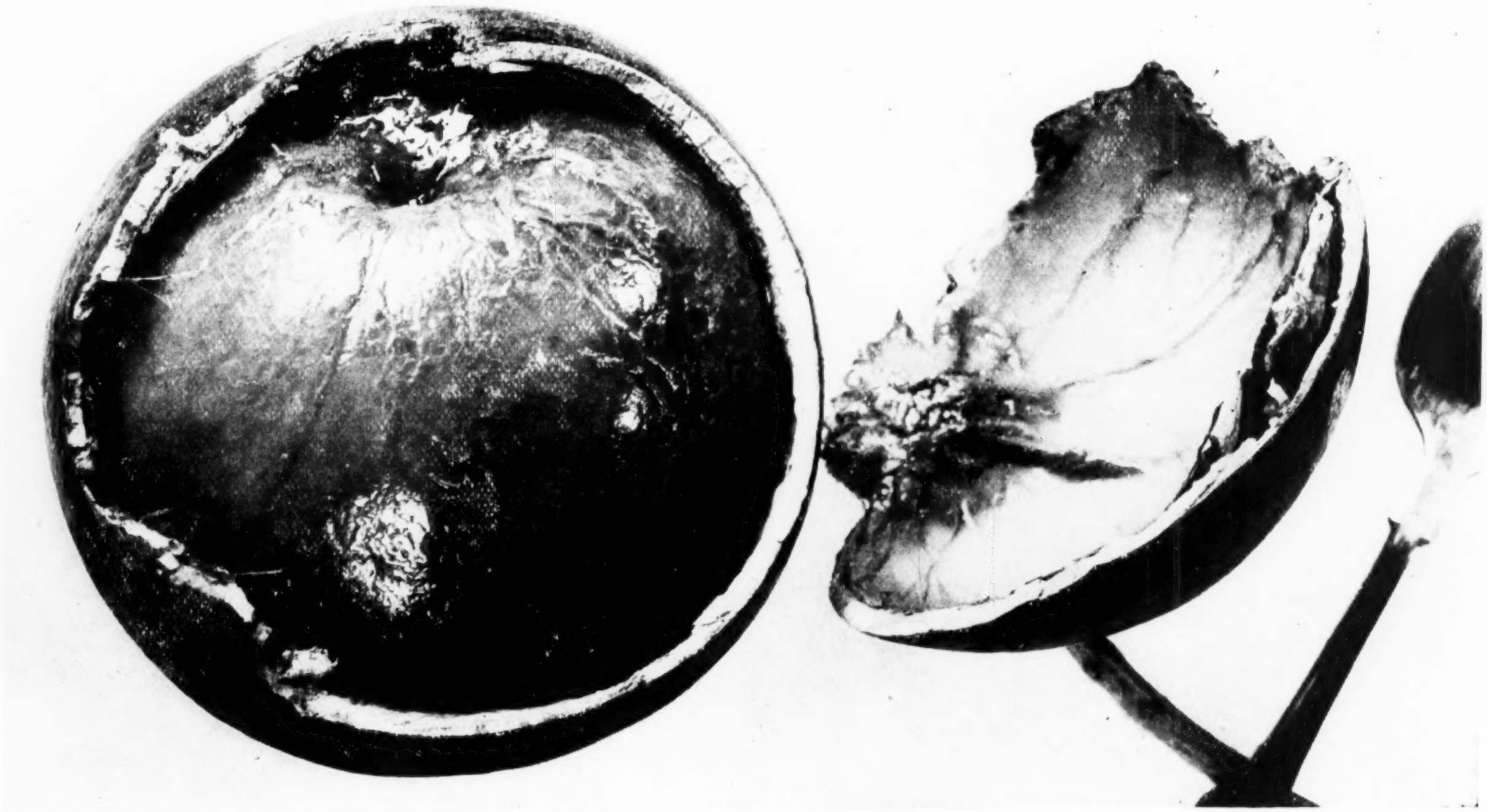
Ten years ago, while I was traveling with Mr. Barbour Lathrop down the east coast of Africa, the American Consul at Delagoa Bay, Mr. Hollis, gave us, just as we were embarking for Cape Town, a strange fruit, about the size and shape of a small cannon ball. He remarked that it was known as the Kafir orange and was considered good to eat, but that the seeds were extremely poisonous. As the fruit appeared to be green, I threw it into the rack over my bunk, in the hope that it would ripen. In a day or two I began to be conscious of an agreeable, spicy perfume which pervaded my cabin, and I traced it to this Kafir orange. Thinking the fruit must be ripe, I tried to open it, but discovered that the shell was too hard to be cut with a knife, and that it required the sharp blow of a hatchet to open it. Not knowing whether the fruit was ripe, and remembering the reputed poisonous character of the seeds, we hesitated to more than taste the fruit, but its singularly spicy aroma and sweet flavor were attractive enough to induce us to send the seeds to America, with a brief account of our experience with the fruit. These seeds arrived in Washington May 6, 1903, were identified as the seeds of *Strychnos spinosa*, Lam., were given F. S. P. Introduction No. 9611, and twelve of them sent to the Miami, Florida, Plant Introduction Field Station the next day.

Nothing further was reported regarding this new plant immigrant until 1906, when a specimen four and one-half feet tall, standing on the station ground, was reported as having had its lower leaves and branches killed by a temperature of 20° F. on Christmas day of that year.



**THE SWEET, PERFUMED KAFIR ORANGE.**

This cannon-ball-like fruit is a member of the family which produces strychnine, and its own seeds contain small amounts of that drug; yet its sweet, aromatic flesh is widely eaten by the natives of East Africa. It has been grown both in California and Florida and has proved fairly hardy; it offers plant breeders an opportunity to produce a unique fruit which, Mr. Fairchild says, is worthy of use to perfume clean clothes, just as the Chinese use their scented quinces.

In 1909 the plant began to fruit and has continued to produce each year a considerable number of these remarkable cannon-ball-like fruits.

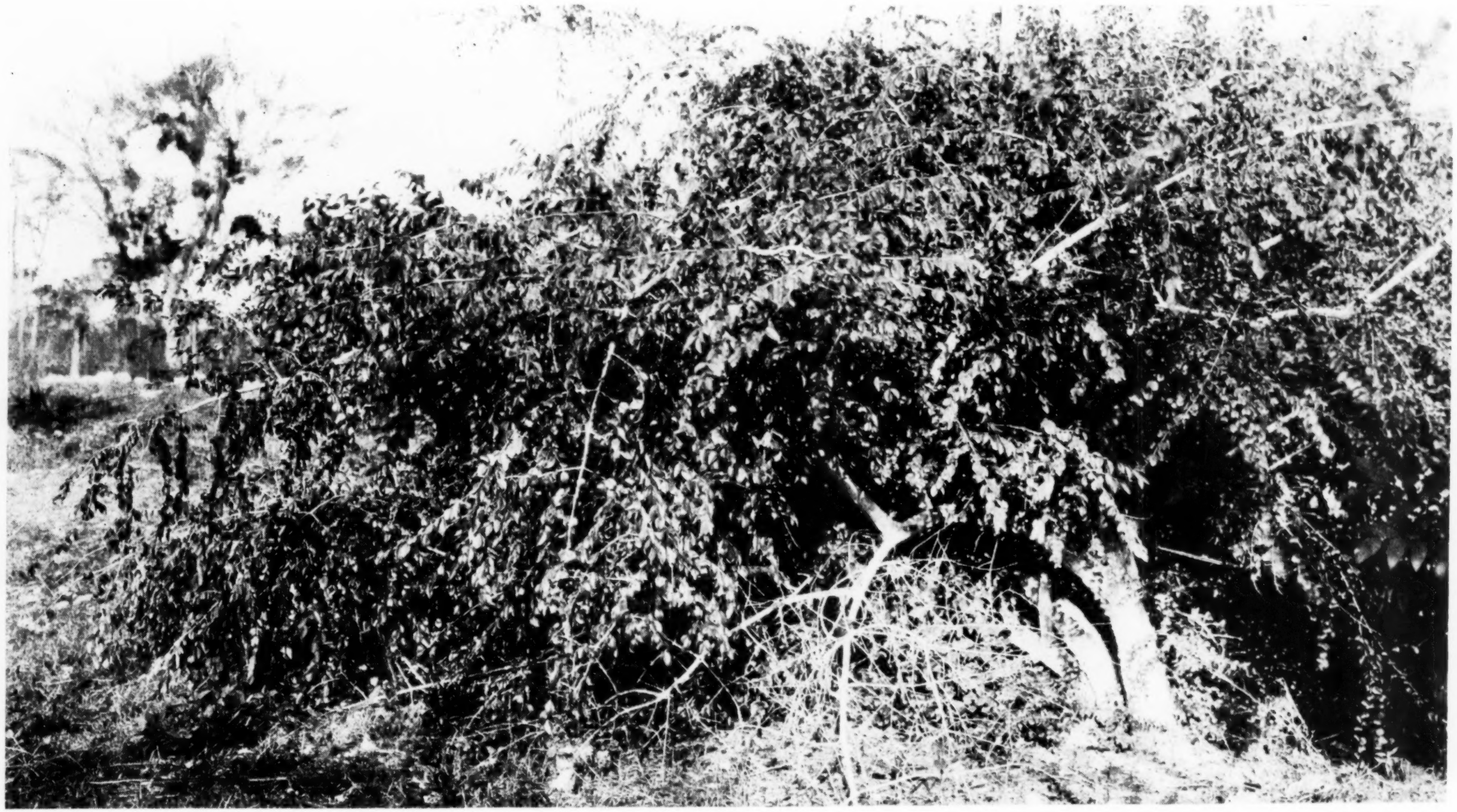
Seedlings of this tree have been distributed in northern Florida and southern California and are now growing there.

I cannot deny that these fruits have always had a peculiar fascination for me. They are so perfectly round that one could almost play croquet with them, the shell being as thick as, or thicker than, that of a calabash. The interior of the fruit is filled with a mass of brown pulp having a ripe banana flavor, with a strong spiciness suggestive of cloves. It has always been interesting to watch the development of the aroma in this fruit as it ripens and changes in color from a brilliant green to a straw-yellow. The Chinese grow a special variety of quince and put the fruits among their clean clothes, and keep them in their dwelling-rooms, because of their delicate perfume, but, personally, I feel like adopting the Kafir orange as my room perfumer. Imbedded in the pulp are a number of large, hard, flat seeds that remind one of the lucky stones of the seashore, said to be the ear bones of some fish. These, it is reported, are extremely poisonous, but an analysis made by Dr. Rodney True, of the Department of Agriculture, failed to discover more than a trace of strychnine in them. It is the *Strychnos nux-vomica* of India which furnishes this extremely poisonous drug.

There is a fascination, too, in the behavior of the shrub—something suggestive of antiquity. The young branches when they form are as tender as an asparagus shoot, and the new growth, which consists of long, pendulous branches, forms quickly in early spring and later falls over and becomes semi-pendulous.

The fact that this East African *Strychnos*, although a totally wild fruit, has shown itself capable of living and bearing in Florida, and has even lived through temperatures which have killed orange and lemon trees in California, makes it worthy of consideration in itself. It is only, however, when we come to investigate its relationships that the problem presented by this Kafir orange appears in its proper proportions.

The literature informs us that there are a hundred species scattered through the tropics of both hemispheres, and though the fruits of many of these are still quite unknown—and of the remainder nobody seems ever to have tasted many—at least eight are known



**THE KAFIR ORANGE TREE AT MIAMI, FLORIDA.**

This *Strychnos spinosa* is closely related to *Strychnos nux-vomica*, which produces the strychnine of commerce; there are nearly a hundred species in the genus, most of which contain strychnine in the seeds, although the flesh is edible. Despite the fact that they are mostly natives of tropical regions, they promise to succeed in favored parts of the United States. With a little improvement through hybridization and selection, they offer a number of unique fruits to American growers.

to bear edible fruits ranging in size from that of a cherry to that of a cannon-ball five inches in diameter.

In *Flora Capensis* published in 1909 a remark regarding the edible character of one of these species is to be found: *Strychnos dysophylla,* Benth., produces a "globose, black berry, sweet, well-tasted, according to Baines, who found it on the red sand flats to the west of Blueberg and Hanglip Mountains, south of the Limpopo River.[1]"

Gilg and Busse, in their paper on the German East Africa species[2] of Strychnos, state that these East African species are characterized by an unusual fruitfulness and that most of them seem not to be poisonous, and that the natives are known to eat the fruits of *S. tonga, S. quaqua, S. behrensiana, S. goetzei and S. euryphylla.*

*Strychnos tonga,* Gilg, is an erect tree which bears globose fruits three and one-half to four inches in diameter, having a thick shell like *Strychnos spinosa.* Its large seeds are imbedded in a copious pulp. It occurs in the Mozambique District, German East Africa, at Pangani and in Portuguese East Africa at Quilimane.

*Strychnos quaqua,* Gilg, has been found at Quilimane in Portuguese East Africa and on the border between North Unguru and Useguha at Kwediboma. Although still imperfectly known, it appears to be an erect shrub, twenty-five feet high, with pendant branches. It was in fruit in September, and the fruit is reported to be edible, though nothing has been reported as to the size of this fruit.

*Strychnos behrensiana,* Gilg and Busse, is the commonest species of the genus in the coastal region of German East Africa. It is a small, scraggly tree, twenty-five feet high. It occurs on the Tongue Mountain near Pangani, where it was found in bloom in December, at Sachsenwald near Dar-es-Salaam, where it was in fruit in May, and between Msenga and Mafisi (Usaramo) and at Kilossa. Its native name in the Kiswahili language is *"Mtonga."* The large, warty fruits, three to four inches in diameter, are faded grey-green in color, and the slimy, sweet-tasting, orange-colored pulp is eaten by the natives and devoured by the wild swine and apes.

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[1] Thistleton-Dyer, Sir William, Flora Capensis, Lovell-Reene & Co., 1909, p. 1054.

[2] Gilg, E. und Busse, W. Die Von W. Busse in Deutsch-Ost Afrika Gesammelten Strychnos-Arten. Botanische Jahrbücher für Systematik Pflanzen-Geschichte und Pflanzengeographie von A. Engler, XXIII Bd., 1903, pp. 173-181.

*Strychnos goetzei,* Gilg, is an erect shrub, six feet or so high, bearing smooth, thick-shelled, globose fruits, two to three inches in diameter, and containing a copious pulp, which is reported to be edible. It occurs in East Ungoni and is called by the Kingoni natives, "Mgese," and also at Uhehe, Uchungwe Mountains, at an altitude of 5,000 to 6,000 feet.

*Strychnos euryphylla,* Gilg and Busse, is a small tree, twenty-five feet high, which occurs in the foothills and highlands of the interior of German East Africa at Uluguru; Ungoni Highlands near Kwa-Lituno, where it was in fruit in June and August; Kiroka and Usagara. The fruits are two and one-half to three inches in diameter, with a thick pericarp, and are reported not to be poisonous.

Baker reports that *Strychnos xerophila,* Baker, from Jur: Kurshook Ali's Seriba, has fruits the size of an orange, which are full of pulp and edible, and that *Strychnos burtoni* from Zanguebar, Lower Zambesi, Shupanga, and the valley of the River Shire bears fruits two and one-half to three inches in diameter with edible pulp and large, orbicular, flattened seeds that are roasted and eaten.

Of the South American species and those in other parts of the tropics little information is obtainable regarding the edible character of their fruits. It seems quite natural that as soon as a botanist discovered the genus to which one of these plants belonged he would suspect it at once of being poisonous, because of its relation with *Strychnos nux-vomica.* Enough is now known, however, about them to make the suggestion worth while that some one who is looking for a problem in plant breeding should get together as many representatives as possible in an arboretum collection in the tropics, or on the edge of them, and begin the work of improving this remarkable class of fruits.

The Office of Foreign Seed and Plant Introduction has already introduced several different forms and is searching for others, and would like to get in touch with any amateurs who are interested in the possibilities of improving this class of tropical fruits.

# SEX-LIMITED INHERITANCE

## Relative Influence of the Two Parents on the Offspring—The Heredity of Colors—Practical Breeding Rules*

LEON J. COLE

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Breeders of animals have long held to the idea that the two parents contribute different characters to the offspring, or at least that the sire has a preponderating influence on certain characters while the dam is chiefly responsible for others. In the present paper it is proposed to discuss what scientific basis there is for such a belief in the light of our present knowledge.

The revolutionary effect of Mendel's work on peas has so often been pointed out that there is no need to emphasize it further. But it has a distinct bearing on the question we have under consideration, for Mendel found in the case of all the characters with which he worked that it was the nature of the *character itself* which determined the appearance of the offspring in this respect, and not a question of which parent possessed that character. Thus if a tall pea and a short one were crossed, the resulting offspring resembled in this respect the tall parent, regardless of whether that parent was the mother or father plant. So with the color of the peas, the color of the unripe pods, and all the others of the seven pairs of characters with which he worked; in each case the same one of the characters was dominant over the others in the offspring, regardless of which parent supplied that character to its makeup. When Mendel's work was revived and experiments of a similar nature began to be made on a large number of animals and plants, similar results were obtained, and scientists generally came to believe that it was a matter of indifference which parent supplied a particular character, for the character appeared or not in the offspring entirely according to whether or not it was dominant or recessive to its alternative condition in the other parent.

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* Paper read at the Ninth Annual Meeting of the American Breeders' Association, Columbia, South Carolina, Jan. 25, 1913.

But it was not long before discordant results began to appear. Cases were found in which the ordinary sequence of events followed when one of the parents possessed the dominant character—it appeared in all the offspring; but when the same character was supplied by the other parent a different result was obtained. In this case it was found that about half of the offspring showed the dominant character while the other half lacked it. Furthermore, the remarkable relationship appeared that those offspring showing the character were of one sex, while those lacking it were of the opposite sex. In fact, this sort of inheritance has come to be called "criss-cross inheritance" from the fact that those offspring lacking the character were of the same sex as the parent which supplied it, while those having the character agreed in sex with parent which did not possess it.

An example will help to bring the relationship out more clearly. It was first worked out definitely in the case of the Currant Moth (*Abraxas*), where the ordinary dark type (*A. grossulariata*) is dominant to the lighter form (*A. lacticolor*). But for convenience I shall select an example from my own breeding work with pigeons. There are three colors known to the pigeon fancier which we may call primary. These are black, blue and red. But they do not exhibit this appearance unless there is present some factor which makes them *intense* in coloration. In the absence of this factor for intense, black appears as a dilute black or dun, blue as a dilute blue or silver, and red as a dilute red, called by the fancier yellow or cream. The "intense" factor behaves precisely the same way in inheritance with whatever color or colors it may be associated, so for convenience we may as well consider it only in relation to black. We are thus concerned with the two colors black and dun, and we shall consider that all the birds used as parents are of pure breeding. The outcome of mating a black male to a dun female is entirely in accord with ordinary Mendelian results, as follows:

Black male $\times$ dun female: Offspring = all black.

But the reverse cross gives an entirely different result:

Dun male $\times$ black female: Offspring = males, black; females, dun.

In this case, in other words, the male offspring are like their mother and the female offspring like their father. Does this not

have a familiar sound to the breeder? Have we not often heard the breeder unfamiliar with Mendelism lay down the principle that "daughters take after their sires, while sons resemble their dams?" While we have found this to be true only when the cross is made in one direction, nevertheless the breeder has undoubtedly in many cases dimly discerned a half-truth, and we would do well to examine such cases further in order to see whether they will fall into line with the principles of sex-limited inheritance, as it is called, which have been outlined above.

Under certain conditions we may get results in some respects resembling these of sex-limited inheritance in the case of characters which really are inherited in simple Mendelian fashion. Let us take for example crosses between black pigeons and red ones. Both of these carry the factor for intensity, so that need not here be taken into consideration. If a pure (that is, duplex or homozygous) black be crossed with a homozygous red, all the $F_1$ offspring are black, owing to the dominance of this character, irrespective of the direction in which the cross is made, and in the second generation ($F_2$) segregation occurs in typical Mendelian fashion. But now suppose that instead of a homozygous black female the black we used had been heterozygous for that character, such for example as the females produced in $F_1$, which contain but a single dose of black, or in other words are simplex for that character. The black male bred to a red female would produce all black offspring. The result of breeding the red male to the heterozygous black female, however, would be equal numbers of black and red offspring, just as the dun male bred to the black female gave equal numbers of blacks and duns. The case of the reds is, however, different in one respect, namely, that in this case there is no constant relation between the color of the offspring and their sex—the blacks may be either male or female, and similarly the reds may be either sex—while in the other instance it will be recalled the blacks were all males and the duns all females. This is, however, enough to give us a suggestion that perhaps the female blacks were really heterozygous rather than homozygous after all. A similar assumption has been made as to sex, and if we further assume that the factors for sex and for intensity of pigmentation have a constant relation (that is, coupling or repulsion) in the germ cells, we have a theory which fits all the phenomena observed. There is no need to discuss the relation of these phenomena to the

behavior of the chromosomes, which is a matter of much interest but beyond our present purpose; it is enough to see that the breeding behavior of the pigeons indicates that all females are heterozygous for the factor for intensity, and that there is a constant relation between this factor and sex.

All of the sex-limited characters in poultry and other birds behave in inheritance as if the female were heterozygous with respect to such characters. The same is true of the known cases in *Lepidoptera*. In certain other insects, on the contrary, the breeding evidence points to the male as the heterozygous sex. This is true also in man and in the few cases in other mammals in which sex-limited inheritance has been identified.

The suggestion has already been made that certain phenomena observed by the practical breeder and attributed by him to some sort of association with sex, were in reality cases of sex-limited inheritance. And indeed similar references may be found in many of the works on breeding and heredity. This is especially true of cases of certain defects or pathologic conditions in man, such as color-blindness, hemophilia, and the like (*cf.*, for example, Darwin, Animals and Plants under Domestication, Vol. II., Chap. XIV.), which on later investigation seem clearly to be sex-limited in their inheritance. In these earlier works, however, there was failure to distinguish sharply between secondary sexual characters, those characters which properly belong only to one sex or the other and which depend upon the presence in the body of the sex gland for their full expression, and such characters as are now spoken of as sex-limited or sex-linked. These latter are distinguished by the fact that they may have equal expression in normal individuals of either sex, but when individuals possessing the character (in a duplex condition) are crossed one way with individuals lacking it, all the offspring are uniform in the possession of this character, while the opposite cross gives daughters like the male parent and sons like the mother in this respect.

There is another condition, entirely aside from sex-limited inheritance, which has often given rise to the idea of a differential influence of the sire and dam on the progeny. This is brought about by the method of breeding many of our domestic animals, in which only one male is kept to a large number of females. This increases greatly the individual importance of the male and leads to a much more vigorous selection of sires than of dams. Fur-

thermore the sire has many more progeny, from which his breeding powers may be judged, than is the case of any one dam, which again gives opportunity for closer selection in his case on this basis. For example, a Holstein bull heterozygous for black, would undoubtedly soon be detected from his getting occasional red calves and he would consequently in all probability be eliminated as a breeder. The chances of a heterozygous cow being bred to a heterozygous bull are consequently lessened greatly, so that the chances of her heterozygosis appearing are correspondingly reduced. Furthermore, even if she should throw a red calf, there is more reason for keeping her, especially if she is a paying producer, and less reason for disposing of her, since her influence on the breeding of the herd is much less than that of the bull. This process undoubtedly tends toward producing homozygosity of sires in horses, sheep, swine, etc., as well as in cattle. As a consequence the proportion of sires in these various animals, which are homozygous with respect to particular characters, is without doubt greater than it is in the dams, and this, especially when dominant characters are concerned, may very naturally lead to the conclusion that the sire has a greater influence than the dam on the offspring. The possibility of this fact has long been appreciated, though of course without its Mendelian interpretation. Thus Miles[1] quotes the following from an article by Dr. Allen Thompson on "Generation":

"The consequence of this has been that more attention has been paid to the blood or purity of race of the stallion, bull, ram and boar, than to that of the females; and hence it may be the case that these males more frequently transmit their qualities to the offspring than do the inferior females with which they are often made to breed. But this circumstance can scarcely be adduced as a proof that the male, *caeteris paribus*, influences the offspring more than the female" (p. 218).

He also gives (*loc. cit.*, pp. 219, 220) a quotation of similar import from Stonehenge's book on "The Horse." This principle was also recognized by Spencer[2] (*loc. cit.*, p. 22), at one time president of the Royal Agricultural Society of England, and he furthermore

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[1] Miles, Manly, "Stock Breeding." New York, D. Appleton & Co., viii, 428 pp., 1907.

[2] Spencer, Earl, "On the Selection of Male Animals in the Breeding of Cattle and Sheep." Journ. Roy. Agr. Soc. Eng., Vol. 1, 1840, pp. 22-29.

emphasized the importance of judging a sire by its offspring. As pointed out above, this is the way in which heterozygous individuals may be detected. After stating (p. 24) that the breeder "should take care that the individual male animal which he uses shall possess the qualities which he requires," he adds: "In addition to this, it is of great importance that these qualities should have been characteristic of the family from which the animal is descended; and if he is old enough to have been the sire of any number of offspring, it is of a great deal more importance still that they should possess them; because all the perfections of shape and quality which the best judge may wish to find in a male animal are, after all, only indications of what the stock got by him will probably be: the seeing, therefore, what they really are is much more satisfactory."

In the light of our present knowledge we can go through the older works on breeding and heredity and find many references which we can now see referred to sex-limited inheritance. For example in a book on color breeding in pigeons we find the statement: "Another cross which may be resorted to if you cannot get a Silver cock—as, strange to say, invariably Silvers are hens—is to breed a Blue cock with a Silver hen" (p. 10[3]) and again (p. 13): "Silver has been little fancied by the fancier for several reasons: one is that 99 per cent of the Silvers bred have been hens." These statements, while perhaps not exact, become intelligible on the basis of the example which was given some time back, if we remember that silver is the dilute condition of blue just as dun is dilute black. In the same work to which reference has just been made we find (p. 3) the general rule laid down:

> "If you want type, get it from your hens—
> If you want color, get it from your cocks."

Going back again to the illustrative example, we note in that case that 75 per cent of the offspring were like their sire in color. This would surely be enough to give the breeder the impression that the male was chiefly responsible for determining the color of the offspring. As to type, it is rather doubtful whether the rule is here correct. Poultry breeders have a similar idea, but its truth is de-

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[3] Chapman, E. R. B., "Color Breeding for the Pigeon Fancier and Amateur." Published by the author, 1911, 47 pp.

nied by many. If such is really the case, it cannot be accounted for by the laws which determine inheritance of color.

Among cattle breeders we find a prevailing impression that "the males of dairy-breeds, generally, are prepotent in the transmission of the characteristics of the females of their race" (Miles, *op. cit.*, p. 231). Sedgwick is quoted in the same place as saying: "It is well known, for example, that the supply of milk by cows is hereditarily influenced by the bulls rather than by the cows from which they are directly descended, and that the character of the secretion, as regards both the quantity and the quality of the milk, is chiefly derived from the paternal grandmother * * *."

This, if true, would fit in well with sex-limited inheritance, and such indeed it may ultimately be found to be. At any rate we should take advantage of all such suggestions, and give such matters thorough investigation. It would practically revolutionize the breeding of dairy cattle if the factor, or even some one of the factors, if there are several, which determine milk-production in cattle, could be found to obey any of the definite laws of Mendelian inheritance. The fact that the factors concerned in egg production of the fowl appear to have been so analyzed[4] should give us great encouragement in this matter.

Finally, just a word of warning should be said in this connection. Too many breeders are of the opinion that if any particular character of a sire appears in a large proportion of his miscellaneous progeny, it indicates a *general* prepotency on the part of that animal, other characters being assumed to be transmitted in the same way. We may pick up almost any book on animal breeding and find such statements as the following: "The galloways among cattle are noted for their prepotency. When crossed upon other breeds and especially upon grades, the progeny are nearly all black and hornless" (Shaw,[5] p. 99). It may be that galloways have other dominant characters as well, but we now know that these are undoubtedly independent of the polled condition and the black color. These would behave just the same if they were possessed in a homozygous condition by an animal of any other breed, or indeed by a grade or even a scrub.

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[4] Pearl, R., "The Mode of Inheritance of Fecundity in the Domestic Fowl." Journ. Exper. Zool., Vol. 13, No. 2, 1912, pp. 153-268.

[5] Shaw, Thomas, "Animal Breeding." New York, Orange Judd Company, 1909, xi + 406 pp.

In conclusion let me pay tribute to the observational powers of the practical breeder. He has seen many of these things, and Darwin in his books has gathered many of the breeders' observations into a mine of information. But without the key which Mendel gave us, anyone who sought an explanation for these phenomena was groping in the dark. Mendelism is beginning to unlock a few of the doors and to disclose the secrets hidden within, but a beginning has only just been made. It is enough, however, to stimulate both the practical breeder and the scientific student of heredity to further observation and experimentation, for but a short time ago we appeared to be facing a solid wall; all the doors appeared to be locked and barred, and we seemed to be making no progress in our attempts to force them open. Now the few rays of light let into the darkness beyond give us great hope for future discovery.

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# Association Matters

Members of the American Breeders Association will be interested to learn that Professor Willet M. Hays, principal founder of the association, formerly its secretary-treasurer, and its most active spirit until his health gave way last winter, has entirely recovered. He sailed for Buenos Aires on October 4, to accept a position in the Argentine government, superintending the establishment and organization of rural education—a subject in which he has always taken a deep interest. Professor Hays, who occupied the post of assistant secretary of the Department of Agriculture for many years, has a very wide circle of personal friends among the breeders of the United States, and all members of the association will wish him success in his new work.

As is noted on the inside back cover page of the magazine, the American Breeders Association has on hand at present copies of only a few of its own back numbers. There is a steady demand for other issues, to fill out sets, and the secretary will be glad to hear from any one who has duplicates or extra copies to exchange or dispose of.

According to a vote at the last annual meeting, the annual meeting of the association in 1915 will be held in connection with the Panama-Pacific Exposition at San Francisco.

# A NEW FORAGE PLANT

## Desmodium Hirtum, Recently Introduced, Promises to be of Value Both as Cover Crop and to Provide Fodder

AD. STOLZ

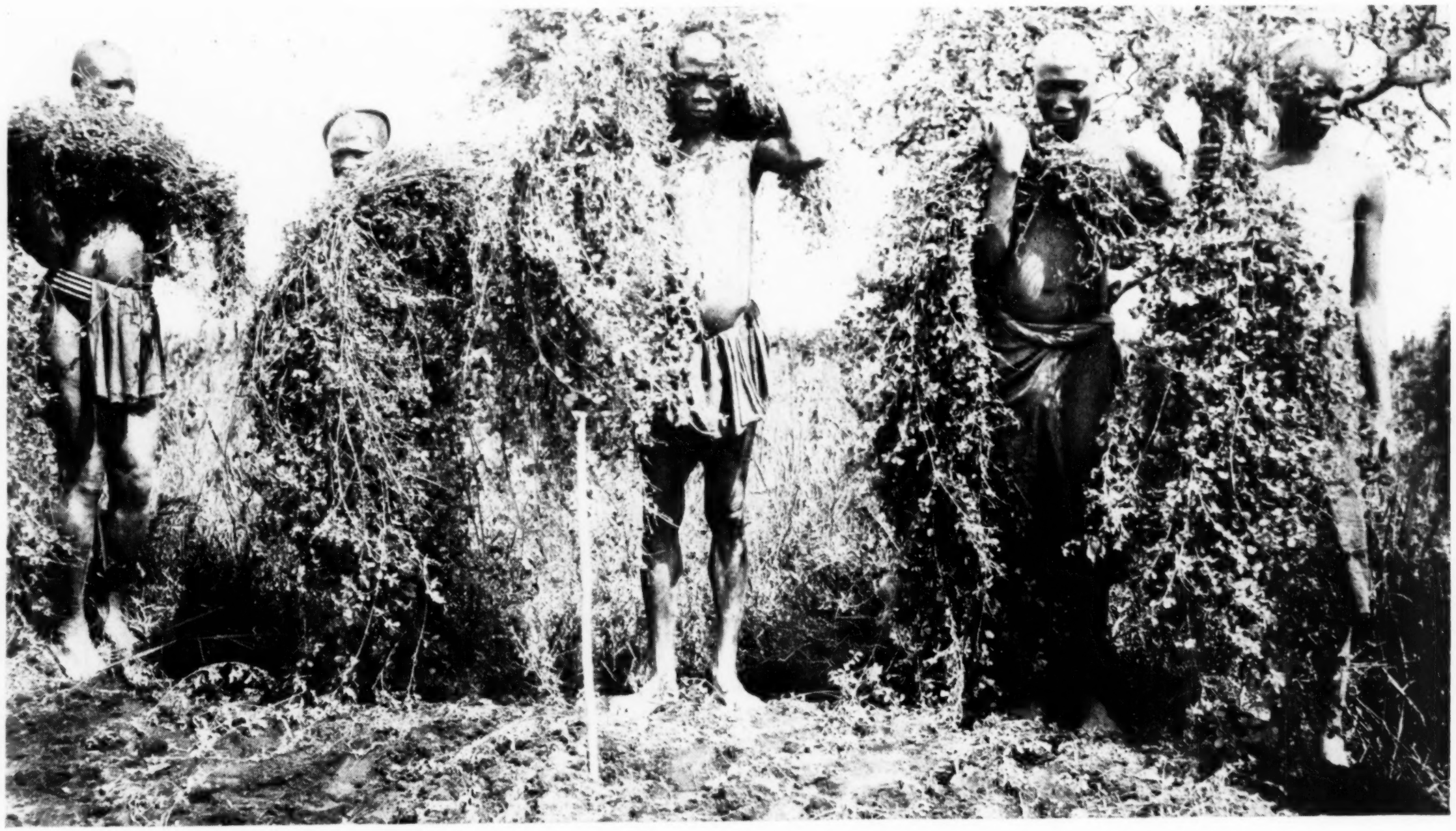
*Mission of the Evangelical Brethren, Kyimbila, German East Africa*

*Among new plants of interest to breeders, high place must be given the interesting forage and cover legume, Desmodium hirtum, of German East Africa, which has been secured by the office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture. Its introduction is due to the German missionary, Ad. Stolz, who gives the following account of it.*

For three years I have carefully cultivated one of the native leguminous plants, *Desmodium hirtum* Guill. and Per., and have become convinced as to its value. With it I have planted *D. barbatum* Benth., a species probably known to Americans, since it is widely distributed in tropical America: it forms low clumps, has in part the same good qualities as *D. hirtum*, but does not grow so rankly and is now gradually overgrown by *D. hirtum*. The latter furthermore has the great recommendation that one can propagate it from rooted cuttings, and thus avoid a long wait to secure seed. If cuttings of one to one and one-half meters in length are used, the desired end can be quickly attained.

In its wild state, I have found this plant at elevations from 550 to 1,600 meters above sea level. It is a typical grass plant, with scanty growth and runner formation between the high grass haulms. I found it with a variety of other leguminous plants, of which our meadows produce abundance, and I tested all the species, but *Desmodium hirtum* turned out to be the best, showing great improvement under cultivation.

It is not to be underrated as forage, for asses and sheep eagerly eat the shoots. I anticipate that it will have great value as a combined cover and forage crop. Such cultures as coffee, tea, rubber, lianas and cedars, have taken on a significant fresh appearance



**A NEW AFRICAN LEGUME.**

The photograph shows native workmen of the Mission of the Evangelical Brethren at Kyimbila, German East Africa, planting shoots of *Desmodium hirtum*, one of the native leguminous forage plants, in a bed. The plant has recently been introduced to the United States where it will be tested not only for its value as a cover crop, enriching the soil by its apparatus for gathering nitrogen from the air and storing it in its roots, as all legumes do, but as a forage crop.

after having *D. hirtum* planted between the rows. This shows itself especially on this year's fresh, powerful shoots of the plants, hence the fertilizing value of this legume must be marked. It fertilizes not only other plants but itself, for where after a space of 12 months a spindling plant wanders through the soil, it raises itself in the following year to an entirely different, luxuriant plant.

On poor soil the shoots lie flat on the ground, reaching a height of two to five cm. On the other hand on good soils the shoots in the first year attain a height of 30 cm. The looser and better the soil is, so much quicker does it develop, and puts forth runners during a year, from one to one and one-half meters long, which quickly root in loose soil and form cuttings for transplanting. The accompanying photograph shows some of my assistants carrying such shoots and planting them in a bed. The plant can be easily grown from seed, too, but in doing so it is worth while, above all, to produce good, strong runners as quickly as possible which, so soon as they have rooted, should be planted during the rainy season, and will rapidly multiply. At first the land must be kept clear of weeds, but the plant will crowd out all weeds after it has once made a start. After seed production the plant dies down almost two-thirds from the rootstock, and the runners which have not dried up soon put forth fresh shoots which grow over the dead parts.

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## Eugenic Belief

Eugenic belief extends the function of philanthropy to future generations. It renders its action more prevailing than hitherto, by dealing with families and societies in their entirety, and it enforces the importance of the marriage covenant by directing serious attention to the probable quality of future offspring. It strongly forbids all forms of sentimental charity that are harmful to the race, while it greatly seeks opportunity for acts of personal kindness as some equivalent to the loss of what it forbids. It brings the tie of kinship into prominence and strongly encourages love in family and race. In brief, eugenics is a virile creed, full of hope, and appealing to many of the noblest feelings of our nature.—Francis Galton.

# SELECTION IN PURE LINES

## Fifty Years' Work in Wheat by Vilmorin Shows Not One of the Varieties Changed in Any Way by These Generations of Selection

MRS. C. AND DR. A. L. HAGEDOORN
*University of Utrecht, Holland*

The question whether genetic factors are constant or variable (factors, not characters) is one of the utmost importance to the practice of breeding as well as to science. As is observed by John Belling in a recent issue of THE AMERICAN BREEDERS' MAGAZINE,* this can only be tested by selection-experiments with material pure for all its genetic factors. In plants such material theoretically is not to be found, as we can never be sure whether or not a plant is pure for such genetic factors as exert no influence on the development of the individual. And we know that several such factors must exist. But in practice, we know that a strain of plants, grown from one single individual by continued self-fertilization, must automatically become pure for all its genetic factors, if in each generation one single individual is taken to propagate the family. And this, even if the first individual were impure (heterozygous) for several genetic factors. Strains of habitually self-fertilized plants bred in this way can, therefore, for all practical purposes be taken for "pure lines." Johannsen showed that selection in such "pure lines" of beans, during several generations, had no effect.

Mr. Belling now observes that Johannsen possibly did not select plants, but seeds, which is quite another thing, and further, that possibly selection might have effect after a very much greater number of generations. There is something to be said for these objections. But if in reality selection can not modify genetic factors, then it ought not to be able to have any effect even in twenty or more generations on pure material.

Now, there happens to exist a series of selection-experiments in pure lines, which has been continued for half a century. Louis de

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* Belling, John: Selection in Pure Lines. AMERICAN BREEDERS' MAGAZINE, Vol. III, No. 4.

**AFTER HALF A CENTURY OF SELECTION.**

Four pure lines of wheat, which have been bred by Vilmorin for 50 years. The original specimen in the seed museum is shown in each case at the left of the pair. At the right is a head of the same variety after it has been selected for half a century. The close similarity of the heads in each pair shows that selection has produced no change in these varieties—once the pure type is segregated it remains constant indefinitely.

Vilmorin, about 1840, started a living museum of pure lines of commercial wheats. Of each variety a single plant, the best, was selected in every generation, and this selection is continued even to this day. In plants with very long ears, the plant with the longest ears is selected, in branched-eared plants, that with the best branched ears, and so on. The seed of each variety sold each year by the firm of Vilmorin is derived from one single plant some generations back. It is the selection-principle reinvented several times by different breeders, amongst others by Nilsson in Svalöf some twelve years ago.

In 1911 Mr. Meunissier, the genetist of the firm of Vilmorin, found the collection of original ears of the varieties with which Louis de Vilmorin half a century back began his living museum. Some of these wheats are from the harvest of 1843, others date from 1850, or intermediate dates. Mr. Meunissier chose three dozen ears of varieties which are still in the collection, and which have therefore been bred continuously as pure lines for about fifty years. We compared these ears to ears of the 1911 harvest, and photographed them side by side. Some of these pairs of ears are here shown, each pair consisting of the old ear, and its descendant, half a century later. As can be easily seen from the photograph, all these generations of selection have not changed any one of the varieties one little bit. It can therefore safely be concluded from this series of experiments, that selection can have no effect in material pure for its genetic factors. Genetic factors are constant.

How then, it may be asked, is it possible that selection can modify almost any character of animals taken at random? The answer is obvious. Selection must necessarily have effect in material which is *not* pure in respect to the genetic factors it contains. Animal populations are nearly always impure for the most diverse genetic factors, even for such as give them their value commercially, and the absence of which makes them worthless. Thus, practically all the very best folds of sheep contain individuals heterozygous for the factor which distinguishes whites from blacks, and therefore produce occasionally a black, worthless lamb, and this, notwithstanding the fact that such lambs are never bred from in such races. Only by weeding out these heterozygotes, whenever they show themselves as such, can one gradually increase the proportion of homozygotes to heterozygotes. One of the best sheep-breeders in Holland is now doing this.

By severely inbreeding a family of animals (brother to sister, parent to child), even such a family must become pure for its genetic factors, for, every time two animals are mated, which both are pure for a given factor, or which both lack it, such an inbred family becomes absolutely and irreversibly pure in respect to this factor. Also, such breeding heightens the probability of bringing two such animals together. Even animals, therefore, may be bred pure. Possibly even some families of pigeons have thus already been rendered pure. It stands to reason, that if we want to know whether, by any chance, selection might be able to modify genetic factors of animals, even if it can not do so in plants, we must be sure that the material with which we start be as pure as the practically "pure lines" of plants.

We therefore challenge anyone, who believes that selection might modify genetic factors in animals, to start a selection-experiment with one brother and one sister, which have any character in the same grade; to breed the family severely in and in (brother to sister, parent to child), to change this character beyond the range of its modifications, *and then to bring it back to its starting point.*

For it is obvious, that it may be possible by selection to get rid of such genetic factors as influence the character selected in a direction opposite to that, in which we want to modify it, and thus to make great progress. On the contrary, if selection really might change genetic factors, modification of any character would be as easy in one direction as in the other.

It would, of course, be hopeless to work over all instances which are said to prove the possibility of a modification of genetic factors by selection. As far as we know, such experiments have always been made with hopelessly impure material, or rather with material which offers not the slightest guarantee of genetic purity. No case ought to be considered seriously, in which the material is not nearly as pure as it can possibly be made, for instance by long-continued strict inbreeding.

Only if our challenge can be successfully answered, will it become necessary to assume the possibility of a variability of genetic factors.

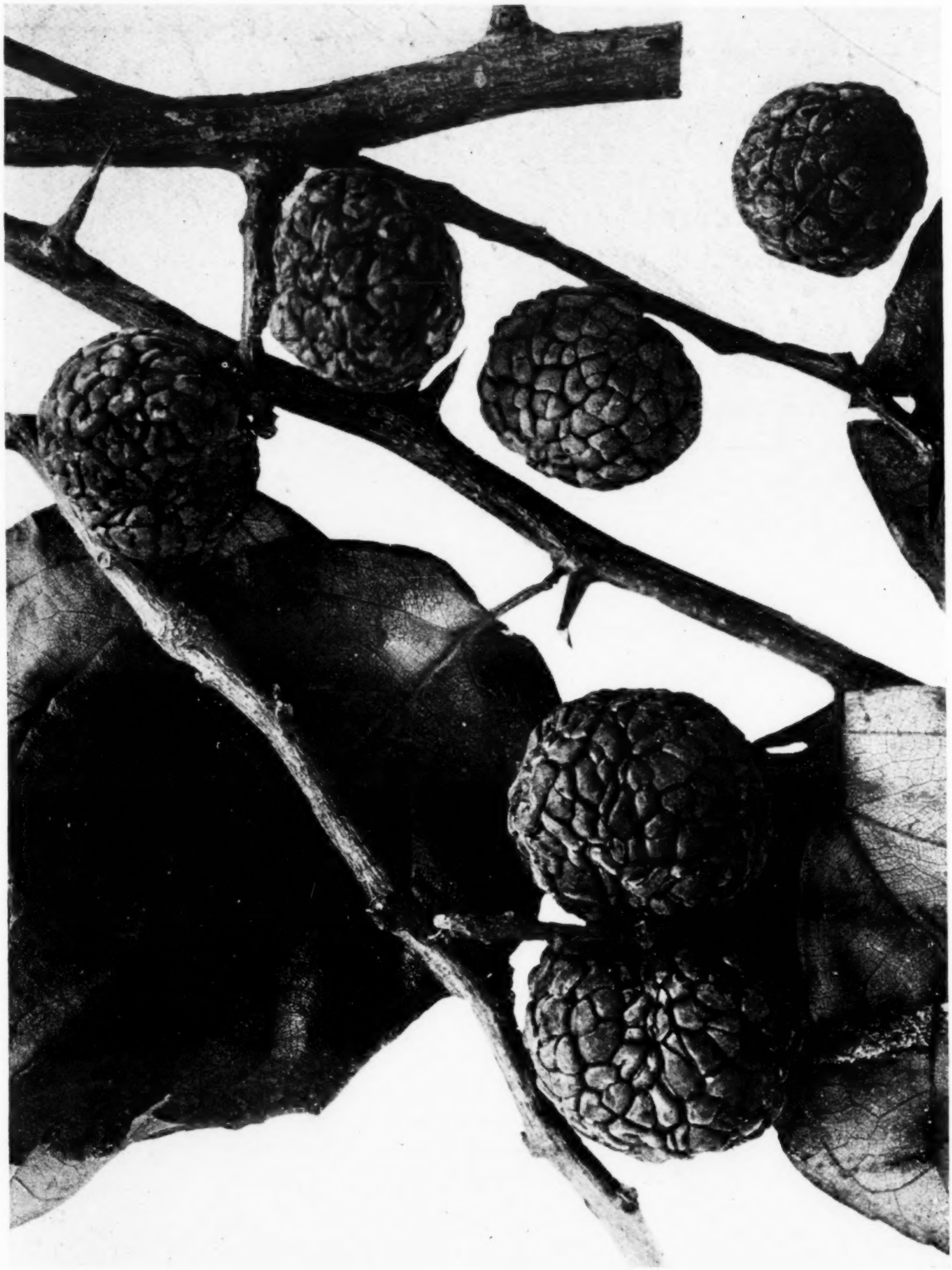
# "AN EDIBLE OSAGE ORANGE"

## Chinese Cudrania, Closely Allied to Common Mock Orange, Promises to be Valuable if Its Size Can be Increased by Hybridization

One of the most interesting but little-known Chinese fruits which has been introduced to the United States during recent years is *Cudrania tricuspidata,* a representative of the natural order Moraceae and closely allied to the Osage Orange of the Middle West. Its fruit, although small (one to one and one-half inches in diameter), is sweet and eatable, and because of its hardiness the shrub can probably be grown throughout the southern half of the United States. If successfully crossed with the Osage Orange, the progeny offers promise of being a source of food for live stock in a wider region, while selection of the fruit itself should result in the establishment of a variety that would be well worthy of cultivation for its fruits.

The first introduction was made by E. H. Wilson, of the Arnold Arboretum, Boston, who secured the tree in Central China, where it is known as Che. More recently Frank N. Meyer, agricultural explorer of the Bureau of Plant Industry, U. S. Department of Agriculture, at Washington, has sent it in from Laoling in the province of Shantung, where it is called Tcho Sang, "wild mulberry." "It is a wild shrub," he reports, "sometimes growing into a small tree, and found in dry places. The leaves are used for feeding silkworms in times of scarcity of mulberry leaves. This plant makes a similar impression to the Osage Orange, but is of much smaller dimensions. It can be utilized in the drier parts of the United States as a hedge plant around gardens, as a fence material on farms, and, in the milder, semi-arid sections, for bank-binding. It is very thorny and can therefore serve very well for hedge purposes." There are several other species with edible fruits.

Specimens sent out by the Arnold Arboretum have already fruited at Augusta, Georgia, where those who have seen the tree have formed a high opinion of its possibilities. R. C. Berckmans, of



**TCHO SANG, THE EDIBLE "OSAGE ORANGE."**

This fruit, resembling the Osage Orange of the United States in appearance and closely related to it, is sweet and edible. It grows rapidly even in poor soil and a dry season. It is already being tried in Georgia as a stock food, and has proved very hardy. If hybridized with the American Osage mock orange, it would probably have a still greater range and make a larger fruit and tree. (Photo natural size.)

the Fruitland Nurseries, writes: "The trees which we have are from seed planted about five years ago. In 1912 we had the first fruit. The trees were then from two and one-half to four inches in diameter, and 10 to 12 feet in height.

"R. O. Lombard, of this county, who is largely interested in hog growing, thought the tree had merit as hog food. Last season we gave him all the trees we had except three. The three which we have in our nursery were cut to the ground, and have made about 10 feet of growth this season. Mr. Lombard also cut his trees back, and tells me that they made about four feet of growth. They would have made more but from the fact that he is in a very sandy section and has had a drought more or less through the entire season. The trees we have here have withstood some severe weather during the past five winters without injury.

"From the above data we would consider this tree rather a rapid grower, and one that will stand very low temperatures—probably zero and maybe lower. It can be readily propagated from seed or roots. I have noticed in the nursery rows where the trees were dug last season that quite a number of small ones have come up from the roots, and some at least 20 feet from where the original tree stood. As to its real merit as stock food we have as yet no real data."

The correspondence of these facts with those furnished by the mock or Osage orange (*Toxylon pomiferum* Raf., *Maclura aurantiaca,* Nut.) is striking. This tree, which is native of the region between eastern Kansas and northern Texas, sometimes reaches a height of 30 to 50 feet, but is best known in hedge form. It is hardy as far north as Massachusetts; grows readily and rapidly either from seed or roots, is a voracious feeder and not particular about soil, bearing its green, woody and inedible fruits, four or five inches in diameter, profusely. Its hard wood is valuable for fence posts. By making hybridizations between these two allied genera, horticulturists over a large area will have a chance to get some exceedingly interesting results.

Although the cross has not actually been performed in the United States, so far as the record shows, it is entirely practicable, for it was made in France by the late Edouard André, editor of *La Revue Horticole,* and described by him in that journal, under the name of *Macludrania hybrida,* in 1905, page 362. He says:

"In January, 1896, I made the readers of the *Revue Horticole* acquainted with a new variety of *Maclura aurantiaca,* fortuitously

produced in the garden of Mme. Helie of Bléré (Indre et Loire), and which I named *Maclura aurantiaca inermis*. In this variety, the spines which arm the branches of this species had entirely disappeared. Moreover, the vigor of the plant is superior to that of the type. It is another beautiful tree added to our collection of ornamentals.

"I added that as the subject was female (it is well known that *M. aurantiaca* is dioecious), I had the idea of fecundating it by pollen from a male specimen of *Cudrania triloba* which I possess at Lacroix and which, each year, in June, is covered with staminiferous globules. It was M. Guy of Bléré who undertook this operation and succeeded in obtaining fertile fruits. The seeds were sown and I obtained half a dozen plants which grew vigorously.

"It is this new hybrid which I now present to our readers.

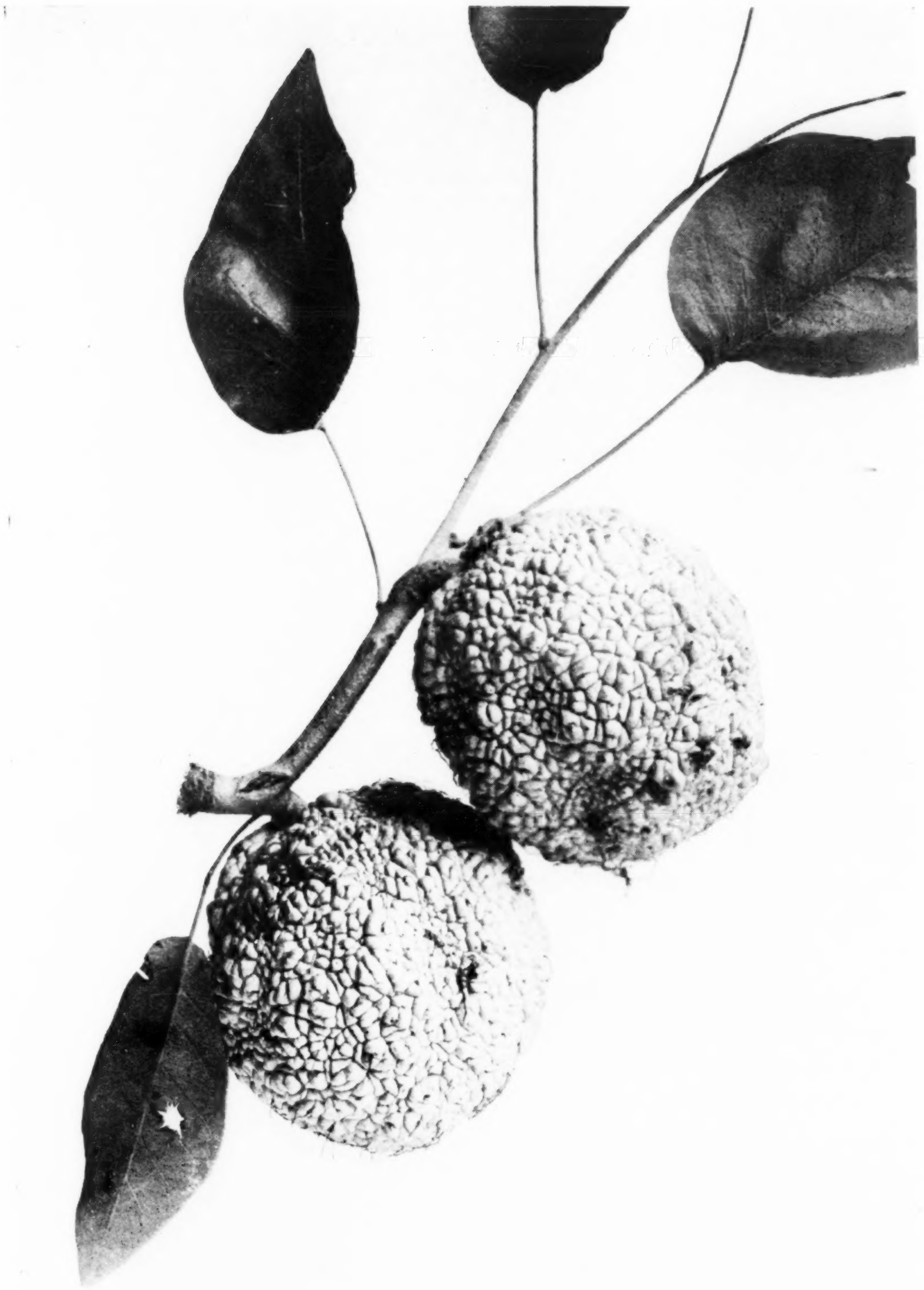
"As the two genera are distinct, although related, I have employed, to create the name of the bigeneric hybrid, the formula which consists in taking the beginning of the first name and the end of the second. We have thus *Macludrania*, with the qualificative *hybrida*.

"The young plants which were grown from these seeds, and which are today in their eighth year, are now beginning to be clearly characterized.

"Until last year, I let them grow freely in their bushy form, which is now being modified by the development of strong shoots which tend to gain predominance over the weaker ones. Pruned specimens have a well-marked trunk, as large as a broom-handle. They have rather the appearance of the *Cudrania*, with its low stature, than the arborescence of *Maclura aurantiaca*. They are uniformly spiny and present no spineless branches, like their mother—which, however, was only an accident in the species. The form and foliage of all the specimens I have are identical. None of them has yet flowered, so I cannot tell whether they are of different sexes.

"The description of *Macludrania hybrida* is as follows:

"A small tree reaching (today) a height of three or four meters, at first bushy, then forming an erect stem with yellow, fissured bark, that of the preceding year being gray-green with transversal grayish-green corrugations; the branches of this year's growth light green at the ends, assuming a violet tint, as well as the upper parts of the petioles. Spines hard, woody, short, straight, at right angles to the axils of the leaves, very sharp, those at the tops of



**THE AMERICAN OSAGE ORANGE.**

A common hedge plant, native from Kansas to Texas. Its fruit reaches a diameter of five inches, but is woody and, except in rare instances, not even eaten by live stock. As the tree is hardy, a hybrid of this native form with the edible Chinese Cudrania may give an edible fruit that can be grown over a wide range in the United States even under adverse conditions of soil and rainfall.

the branches dark brownish-red, almost black. Leaves glabrous, alternate, with milky sap, not polymorphous, slender petiole of a violet shade on top, short (two to three cm.); 15 cm. long and 10 wide, oval, longitudinally acuminate, with very smooth, varnished surface, numerous small veins, the primary ones acutangular, subopposed at the base, all slightly depressed below the surface at the ends, prominent, pale and puberulent towards the base, accompanied, at the swollen base of the petiole, by two very minute, scarious bracts. Flowers unknown.

"This hybrid differs from *Maclura aurantiaca* by its weaker growth, its adult branches smaller and dark brown, its spines, at right angles to the axils of the leaves like *Maclura* but more numerous, closer together, shorter, very sharp and woody, those at the top reddish brown, almost black in autumn. It is more like *Cudrania triloba* in the slenderness and dark color of its aduit branches, and differs from it in its short spines, not decurvent, the stipules of its young leaves shorter, the limbs not subcordiform at the base and more longitudinally acuminate, the absence of three-lobed leaves in its young growth. We will see later if these differences are accentuated in the organs of reproduction and in the leaves of the flowering branches.

"But it is curious to notice that the product of these two genera is much nearer the father than the mother, and we have every reason to suppose that the characteristics of the *Cudrania* will retain their predominance in it.

"The polliniferous tree, the *C. triloba* in the park at Lacroix, today measures eight meters in height, with a head seven meters in diameter. Its trunk is two meters long and 65 cm. in circumference at a meter from the ground. It is certainly one of the most vigorous specimens which exist in France. It now is a tree of great elegance, its lustrous foliage is never attacked by insects, and its innumerable little globes, the male flowers, pale yellow, almost creamy, exhale a sweet perfume during the fortnight (from June 15 to July 1) when they spread their pollen abundantly before falling to the ground. The tree was introduced from China to the Museum (Paris) in 1862."

It is necessary to note that the specific name *triloba* which M. André used has been set aside by the earlier one of *tricuspidata*. Although the French experiment does not give conclusive evidence as to the range of these trees, it is encouraging enough to make wide experiments at once desirable in the United States.

# TO BRAZIL FOR NEW PLANTS

## Expedition Sent to Unexplored Country Promises to Obtain Many Things of Interest to American Plant Breeders—Problem of the Navel Orange of Bahia

The departure on the Steamer *Van Dyck,* October 4, of Messrs. P. H. Dorsett, A. D. Shamel, and Wilson Popenoe, for an exploring trip in Southern Brazil, inaugurated a new policy in the work of the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture. Heretofore the search for new plants has been made single-handed. Each explorer has been called upon to do practically all his own scientific work, except in so far as hired guides, interpreters and laborers, picked up in the countries through which he traveled, have aided him. The large amount of detail work involved merely in getting from place to place in a strange country, has necessarily limited the number of observations recorded, the number and character of photographs taken and the botanical material collected.

This expedition has gone out fully equipped to get not only the living seeds and plants which are necessary, with which to begin experiments in this country, but as complete herbarium material as possible which will enable all new plants discovered to be scientifically identified and, what is nowadays quite as important, to make natural-size photographs illustrating the important characters of the plants and all phases of their culture by the Brazilians.

This expedition has been made possible through the hearty cooperation of the Office of Horticultural Investigations, in allowing Mr. Shamel, its physiologist, to form one member of it, and in providing part of the funds of the expedition.

The researches of Mr. Shamel in California have revealed the remarkable fact that the Bahia navel orange, the first trees of which were introduced from Bahia in 1870 by Dr. William Saunders, of the Department of Agriculture, is now represented by at least nine bud-variation strains. These types or strains have been propagated by nurserymen, without being recognized by them, for the last 40 years. Some of them are valuable strains and others

quite worthless, and the citrus growers of California are now top-working thousands of trees of the worthless strains with grafting wood of the superior ones.

The rumors brought by nearly every traveler up the coast of Brazil to the effect that the Bahia navel oranges in Bahia itself are superior to our California navels and the fact, ascertaind by correspondence, that the Brazilians recognize two distinct types of stocks for this variety, make it seem of great importance to have made by the man who is most competent to do it, a thorough study of the navel-orange situation in Brazil. Did we get in 1870 the best strain of Bahia navel orange and are we now using the best stock for it, are questions whose elucidation will form one of the principal objects of the expedition.

The Maté industry of Brazil has reached such proportion that it is worthy of careful investigation, inasmuch as it can be produced for a fraction of the cost of tea and will supply the same alkaloid in a more easily soluble form. Promising forage grasses, a whole range of new sub-tropical fruits, several new fibre plants, rubber-producing species and bamboos are some of the many possible introductions from Southern Brazil.

The region is comparatively little known, however, and it is expected that many plants of interest to American cultivators, but not recorded in the literature, will be discovered. As the uplands of Southern Brazil are visited by frosts, and as there are dry desert regions surrounded by dense forest areas, the chances for finding plants adapted to the South seem particularly good.

The expedition will confine its work this season to the provinces of Bahia, Rio, Minas and Sao Paulo, and it is expected that a preliminary survey of the situation there can be made in about six months' time, although it is anticipated that at least one member of the association will remain longer in the field.

The office of Foreign Seed and Plant Introduction will be glad to learn from plant breeders of any material known to them, which should be secured by the expedition during its stay in Brazil.

DAVID FAIRCHILD.